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Osteology of Miocene fossil fishes from the Nevada Test Site

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Osteology of Miocene Fossil Fishes from the Nevada Test Site

(To Mock a Killifish)

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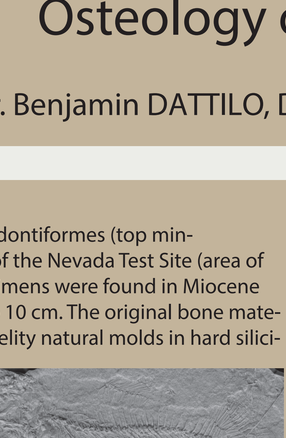
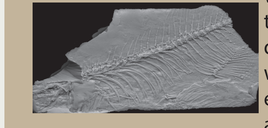
Abstract:

Fossilized remains of an unknown species of cyprinidontiformes (top minnows/pupfish) fish were recovered on the grounds of the Nevada Test Site (area of which is currently closed off to the public). The specimens were found in Miocene volcaniclastic lake sediments and range in size up to 10 cm. The original bone material of most specimens was missing, leaving high-fidelity natural molds in hard silicified silt. Silicone rubber molding compound was used to reproduce the original appearance of the bones. Images of these rubber casts were made with a high-resolution, flat-bed scanner and with a scanning electron microscope. From these images it is possible to compare the skeletal structure of these fish to modern fish, and to other Miocene fish fossils. While the species has not yet been determined, it appears that only one species is represented, suggesting a stressed environment in these volcanic lakes. The high resolution casts also show growth lines on the scales and ostracods in the gut, giving a clue to the food web of the original community. This study gives us a window into the late Cenozoic era, and the environment of the fish. Like their ancient counterparts, modern topminnows live in extreme habitats. Finding how these fish met their end could give us insight into how we might protect similar, threatened, species today.

Introduction:

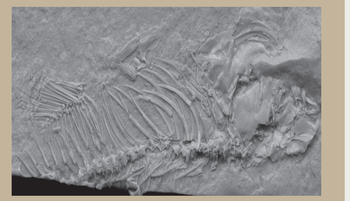
During the late Cenozoic era, the United States as we know it was a very different place. As time progressed, significant global climate change and increased tectonic activity drastically changed the terrain and environment in which the fish in question would have lived. Cyprinidonts are known to be found in bodies of water that may not be suitable for most other creatures. Due to their ability to thrive in these harsh and changing conditions, cyprinidontiformes are key to understanding the ecology of the western United States throughout the Miocene epoch. With the Rocky Mountains to the west and a series of basins confining them to the modern state equivalent of Nevada, the fish in question would have had limited gene flow, as well as limitations of space and resources. By understanding the lives that these fish may have lived, we can begin to piece together what the exact limitations were for this particular species. In turn giving us the ability to answer questions such as; what may have caused the death of these fish? What was the environment like in which they lived? What was the trophic structure of the ecosystem of which they inhabited? Since similar species are alive today, the information recovered from this study could provide the details needed to help stabilize threatened ecosystems.





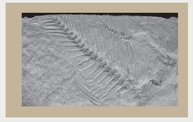
Methods:

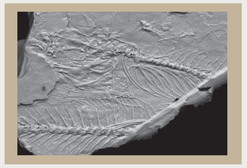
- Silicone molding was used to "re-create" fossils.
- Molds were scanned using a high-resolution scanner to ensure even the slightest detail could not be overlooked.
- Scans were then thoroughly observed, using colors to indicate any defining features that may have been present.
- After studying the osteology and morphology of the fish, we then cross referenced their traits with known species, live and extinct.

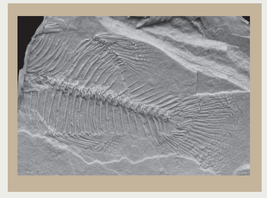


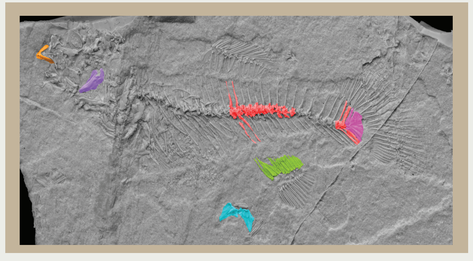
Observations:

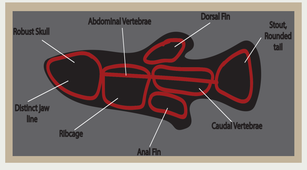
- Specimens range in size and appear to all belong to a single species, indicating death by a "sudden" catastrophic event.
- Vertebral column as well as ribs and caudal fan are very well preserved in most cases.
- Although skulls of fish are crushed it is still possible to identify the origin of certain bone fragments.
- Visible stomach contents at time of death indicate a diet consisting of primarily ostracods.
- Some specimens have preserved indentations of scales. Some of which are detailed enough to indicate growth lines.







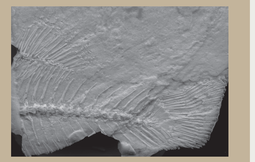




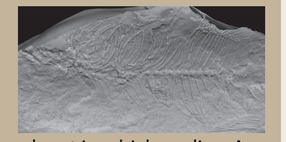
- Colored picture shows specific identifiable osteological structures. Mandible (Orange), caudal vertebrae (Red), hemael spines (Green), pelvic girdle (Blue), lower jaw (Purple), and the caudal fan (Pink).
- Illustration depicts rough reconstruction of the cyprinidont. Important areas of focus are labeled.

Discussion:

As was previously stated, due to the fact that these cyprinidontiformes are known to inhabit harsh environments, it can be assumed that the area in which these fossils were found was, at one point, less than pleasant. This environment could have been created by any number of processes. Increased salinity/temperature? A decrease in essential minerals or nutrients? It's hard to say for sure, however it is known that these fossils were discovered in volcaniclastic lake sediments. This bit of information tells us that volcanism was a very real threat during this time. Tectonic activity at this time would have been much more prevalent, and therefore volcanic eruptions of all sorts would have been a fairly common occurrence. Something as simple as a light ash deposit would have been enough to suffocate a population of fishes within a general area. Along with understanding the habitat in which they lived, the fishes diet is quite well preserved within the guts of some of the specimens. The ostracods on which these fish would have preyed are small crustaceans, primarily found on or in the sediments of aquatic or marine environments. This type of predatory behavior is quite commonly observed with the species of cyprinidontiformes alive today.



Conclusion:



As we continue to study these fossils, we hope to improve our knowledge of the lives of these fish. The importance of paleontological studies such as this is very relevant in todays world. By gaining knowledge of the past we might be able to ensure the future stability of the planet in which we live. As more and more species become endangered or extinct, we have the ability to use evidence from studies such as this to improve or simply stabilize modern ecosystems. Although the fauna found on earth millions of years ago may seem completely different, we can still use this information to create a baseline from which to focus our efforts of species conservation.

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Acknowledgements:

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